

IN THE SPECIFICATION:

Please amend the specification as follows:

Please substitute the paragraph beginning at page 1, line 7, with the following.

-- The present invention relates to an electron beam exposure apparatus and a semiconductor device manufacturing method and, more particularly, to an electron beam exposure apparatus which performs pattern drawing using electron beams and a semiconductor device manufacturing method using the same. --

Please substitute the paragraph beginning at page 3, line 10, with the following.

-- However, a contact mechanical element suffers from problems about lubrication, particles, and the like. To solve such problems, there is disclosed an X-Y transfer stage comprising a stage arrangement which includes a vacuum air guide and a linear motor, and has two degrees of freedom in a plane direction, as shown in Fig. 5. According to the stage arrangement of Fig. 5, a stage can accelerate extremely smoothly in the X and Y directions and the stage can be hardly disturbed by a guide in alignment in the X and Y directions. --

Please substitute the paragraph beginning at page 6, line 13, with the following.

-- Consider the case of a multi electron beam exposure apparatus using a plurality of beams. For example, if the plurality of beams ~~comprise~~ comprises two beams, and a distance between the beams is 10 mm, only one beam can be positioned at the intersection point of the measurement axes. As for one beam, a positional shift from a beam position at the intersection

point is the same as that described in the case of a single-beam exposure apparatus. As for the other beam, a positional shift occurs in accordance with a distance from the intersection point of the measurement axes. If a 100- μ rad stage rotates with the above-mentioned beam distance, a difference between the positional shift amounts of the respective beams becomes 1000 nm. --

Please substitute the paragraph beginning at page 7, line 7, with the following.

-- Under the circumstances, there is a need for an electron beam exposure apparatus having high-frequency band control characteristics in the yawing direction of a stage in order to reduce a degradation in drawing accuracy due to the yawing component of the stage and to realize high-accuracy exposure. --

Please substitute the paragraph beginning at page 8, line 3, with the following.

-- According to a preferred embodiment of the present invention, preferably, the electromagnetic actuator includes a movable element and a stator, the movable element is being fixed on the substrate stage, and the stator is being fixed on the transfer stage. --

Please substitute the paragraph beginning at page 8, line 8, with the following.

-- According to a preferred embodiment of the present invention, the movable element and the stator are preferably in non-contact to with each other. --

Please substitute the paragraph beginning at page 8, line 26, and ending on page 9, line 6, with the following.

-- According to a preferred embodiment of the present invention, the apparatus preferably further comprises a second electromagnetic actuator arranged between the substrate stage and the transfer stage to drive the substrate stage in at least one of a rotation direction about an X-axis, a rotation direction about a Y-axis, a Z-axis direction, and an X-Y direction with respect to the transfer stage. --

Please substitute the paragraph beginning at page 9, line 21, and ending on page 10, line 3, with the following.

-- According to the second aspect of the present invention, there is provided an electron beam exposure apparatus using a plurality of electron beams, the apparatus comprising a substrate stage on which a substrate is mounted, a transfer stage which drives the substrate stage on an X-Y plane, and an electromagnetic actuator which drives the substrate stage, in a rotation direction about a Z-axis and a direction perpendicular to an array direction of the plurality of electron beams, with respect to the transfer stage. --

Please substitute the paragraph beginning at page 12, line 26, and ending on page 13, line 10, with the following.

-- Electrons emitted from the light source form a substantially parallel electron beam through a condenser lens 2, whose front focal position is located at the light source position. The

substantially parallel electron beam comes incident on an element electron optical system array 3. The element electron optical system array 3 is formed by arranging a plurality of element electron optical systems, each comprising a blanking electrode, an aperture, and an electron lens, in a direction perpendicular to the optical axis parallel to the Z-axis. The element electron optical system array 3 will be described in detail later. --

Please substitute the paragraph beginning at page 13, line 11, and ending on page 14, line 2, with the following.

-- The element electron optical system array 3 forms a plurality of intermediate images of the light source. The respective intermediate images are reduced and projected onto a wafer 5 serving as a substrate by a reduction electron optical system 4 (to be described later), to form light source images on the wafer 5. The respective elements of the element electron optical system array 3 are set such that the spacing between adjacent light source images on the wafer 5 is an integer multiple of the size of each light source image. Additionally, in the element electron optical system array 3, the position of each intermediate image in the direction of the optical axis is differently adjusted in accordance with the curvature of field of the reduction electron optical system 4. The element electron optical system array 3 also corrects, in advance, an aberration that occurs when each intermediate image is reduced and projected onto the wafer 5 by the reduction electron optical system 4. --

Please substitute the paragraph beginning at page 14, line 21, and ending on page 15, line 4, with the following.

-- A deflector 6 deflects a plurality of electron beams from the element electron optical system array 3 to displace a plurality of light source images on the wafer 5 by substantially the same displacement amount in the X- and Y-axis directions. The deflector 6 includes a main deflector₁ which is used when a deflection width is large₁ and a subdeflector₁ which is used when the deflection width is small (both not shown). The main deflector is an electromagnetic ~~deflector~~ deflector, while the subdeflector is an electrostatic deflector. --

Please substitute the paragraph beginning at page 15, line 12, with the following.

-- A θ z tilt stage 11 serving as a substrate stage has a wafer 5 on it and can move in the direction of the optical axis (direction substantially parallel to the Z-axis), the rotation direction (θ direction) about the Z-axis, and the tilt direction. --

Please substitute the paragraph beginning at page 16, line 16, with the following.

-- As shown in Fig. 2, the center slider 12 can move in the X and Y directions on the X-Y plane, which is perpendicular to the direction (substantially parallel to the Z-axis) of the optical axis and parallel to the stage base 15. As the center slider 12, an X-Y transfer stage as shown in Fig. 4 can also be used. --

Please substitute the paragraph beginning at page 17, line 2, with the following.

-- As shown in Fig. 2, a θ linear motor movable element 106, which constitutes a part of an electromagnetic actuator and a θ linear motor stator 106', which constitutes the remainder of the electromagnetic actuator, are provided between the θ z tilt stage 11 and the center slider 12. The θ linear motor movable element 106 and θ linear motor stator 106' drive the θ z tilt stage 11 in at least the rotation direction about the Z-axis with respect to the center slider 12. More specifically, the θ linear motor movable element 106 is fixed at the end of the θ z tilt stage 11, and the θ linear motor stator 106', is fixed on the bottom plate 12b of the transfer stage 12 to face the θ linear motor movable element 106. Since the θ linear motor movable element 106 and θ linear motor stator 106' are in non-contact to with each other, the substrate stage can be driven in a non-contact manner. From a thermal viewpoint, it is preferable that the θ linear motor movable element 106 comprises a magnet, and the θ linear motor stator 106' comprises a coil. --

Please substitute the paragraph beginning at page 17, line 23, and ending on page 18, line 12, with the following.

-- The θ linear motor movable element 106 and θ linear motor stator 106' are preferably coated with multiple electromagnetic shields. For this reason, a magnet serving as the θ linear motor movable element 106 is preferably coated with multiple electromagnetic shields of, e.g., permalloy to avoid any variation in the magnetic field. In addition, the magnet serving as the θ linear motor movable element 106 is preferably spaced apart from the reduction electron optical system 4 by a sufficient distance to avoid any variation in magnetic field due to a leakage magnetic field from the reduction electron optical system 4. More specifically, the θ linear

motor movable element 106 and the wafer 5 are desirably located on the opposite sides of the barycenter of the center slider 12 in the Z-axis direction. The θ linear motor stator 106' may be arranged on the tilt frame 13. --

Please substitute the paragraph beginning at page 21, line 13, and ending on page 22, line 7, with the following.

-- In this embodiment, the tilt frame 13 shown in Fig. 2 is not always necessary. Since the linear motor movable elements and linear motor stators are in non-contact ~~to~~ with each other, the substrate stage can be driven in a non-contact manner. It is thermally preferable that each linear motor movable element ~~comprise~~ comprises a magnet, and each linear motor stator ~~comprise~~ comprises a coil. Each electromagnetic actuator is preferably coated with multiple electromagnetic shields. For this reason, a magnet serving as the linear motor movable element is preferably coated with multiple electromagnetic shields of, e.g., permalloy to avoid any variation in magnetic field. In addition, the magnet serving as the linear motor movable element is preferably spaced apart from a reduction electron optical system 4 by a sufficient distance to avoid any variation in magnetic field due to a leakage magnetic field from the reduction electron optical system 4. More specifically, each linear motor movable element and the wafer 5 are desirably located on the opposite sides of the barycenter of the center slider 12 in the Z-axis direction. --

Please substitute the paragraph beginning at page 23, line 8, and ending on page 24, line 10, with the following.

-- A θ linear motor movable element 106, which constitutes a part of an electromagnetic actuator, is fixed on the side surface of the θ z tilt stage 11. A θ linear motor stator 106' which constitutes the remainder of the electromagnetic actuator is fixed on the bottom plate 12b to face the θ linear motor movable element 106. Since the θ linear motor movable element 106 and θ linear motor stator 106' are in non-contact ~~to~~ with each other, the substrate stage can be driven in a non-contact manner. It is thermally preferable that the θ linear motor movable element 106 ~~comprise~~ comprises a magnet, and the θ linear motor stator 106' ~~comprise~~ comprises a coil. The θ linear motor movable element 106 and θ linear motor 106' are preferably coated with multiple electromagnetic shields. For this reason, a magnet serving as the θ linear motor movable element 106 is preferably coated with multiple electromagnetic shields of, e.g., permalloy to avoid any variation in magnetic field. In addition, the magnet serving as the θ linear motor movable element 106 is preferably spaced apart from a reduction electron optical system 4 by a sufficient distance to avoid any variation in magnetic field due to a leakage magnetic field from the reduction electron optical system 4. More specifically, the θ linear motor movable element 106 and the substrate are desirably located on the opposite sides of the barycenter of the center slider 12 in the Z-axis direction. The θ linear motor stator 106' may be arranged on the tilt frame 13. --

Please substitute the paragraph beginning at page 25, line 1, with the following.

-- The manufacturing process of a semiconductor device using an electron beam exposure apparatus according to a preferred embodiment of the present invention will be described next.

Fig. 8 shows the flow of the whole manufacturing process of the semiconductor device. In step 1 (circuit design), a semiconductor device circuit is designed. In step 2 (mask formation), a mask having the designed circuit pattern is formed. In step 3 (wafer manufacture), a wafer is manufactured by using a material such as silicon. In step 4 (wafer process), called a preprocess, an actual circuit is formed on the wafer by lithography using the prepared mask and wafer. Step 5 (assembly), called a post-process, is the step of forming a semiconductor chip by using the wafer formed in step 4, and includes an assembly process (chip encapsulation). In step 6 (inspection), the semiconductor device manufactured in step 5 undergoes inspections such as an operation confirmation test and a durability test. After these steps, the semiconductor device is completed and shipped (step 7). --